Large-area Tracking and Rendering for Extended Reality

Nick Michiels[1,*], Lode Jorissen[1], Fabian Di Fiore[1], Kristof Overdulve[1], Joni Vanherck[1], Isjtar Vandebroeck[2], Haryo Sukmawanto[2], and Eric Joris[2]

[1]Hasselt University - Flanders Make - Expertise Centre for Digital Media, Diepenbeek, Belgium
[2]CREW - CREW Brussels, Vandernootstraat 23/ 8, Sint-Jans-Molenbeek, Belgium
[*]Corresponding author: nick.michiels@uhasselt.be

Abstract

As extended reality (XR) technologies continue to evolve, the potential for larger and more immersive experiences grows. However, one of the key challenges in expanding XR applications beyond small, room-sized environments is the issue of tracking accuracy over larger areas. Current XR headsets, primarily designed for living room-scale games, training sessions, or performances, are prone to drift when used in more extensive settings. This drift leads to a misalignment between the virtual and physical worlds, which undermines the immersive experience and presents significant technical barriers for applications requiring precise spatial alignment.

This presentation introduces a groundbreaking approach to overcoming these challenges, focusing on recent advancements in large-area tracking and visualization. We will discuss how novel solutions developed by the research team at UHasselt, in collaboration with creative industry partner CREW, can be applied to scale up live cultural performances and various industrial use cases. Our approach integrates existing off-the-shelf XR headsets tracking technologies with newly developed tracking technologies that aims to mitigate the drift issue. By leveraging physical ground truth landmarks within the environment and adapting a SLAM-based (Simultaneous Localization and Mapping) tracking algorithm, we have enhanced the ability of XR systems to maintain precise alignment over larger indoor areas. This advancement not only preserves the immersive quality of the XR experience but also opens up new possibilities for applications that require expansive and challenging indoor environments.

The presentation will highlight the practical application of these technologies in live creative performances, where participants can roam and interact across much larger areas

than traditionally possible. CREW is pioneering the use of this large-area tracking technology in cultural performances, allowing up to eight participants to simultaneously engage in an immersive experience without losing synchronization between the virtual and physical worlds (Figure 2). We will share insights into the advantages and challenges encountered during the development and implementation of these performances, offering valuable lessons learned for others looking to explore similar applications.

Beyond the cultural sector, this technology holds significant promise for industrial applications, particularly in manufacturing and construction. In the manufacturing domain, we will demonstrate how our large-area tracking system can be utilized to scan and monitor an industrial shop floor in a cost-effective manner, enabling real-time, photorealistic visualizations of the workspace, which can be a valuable asset for cognitive support and operator guidance (Figure 1). In the construction industry, we will showcase how this technology facilitates the accurate overlay of 3D electrical wiring in augmented reality (AR), enhancing the efficiency and precision of construction projects.

By addressing the critical issue of drift in large-scale XR environments, our research can be an supporting technology for more expansive, accurate, and immersive XR experiences. This presentation will not only demonstrate the technical feasibility of these solutions but also illustrate their practical impact on both the cultural and industrial sectors. Attendees will gain a comprehensive understanding of the current state of practise of large-area XR tracking technology, the opportunities it presents for various applications, and the potential for future innovations in this exciting field.

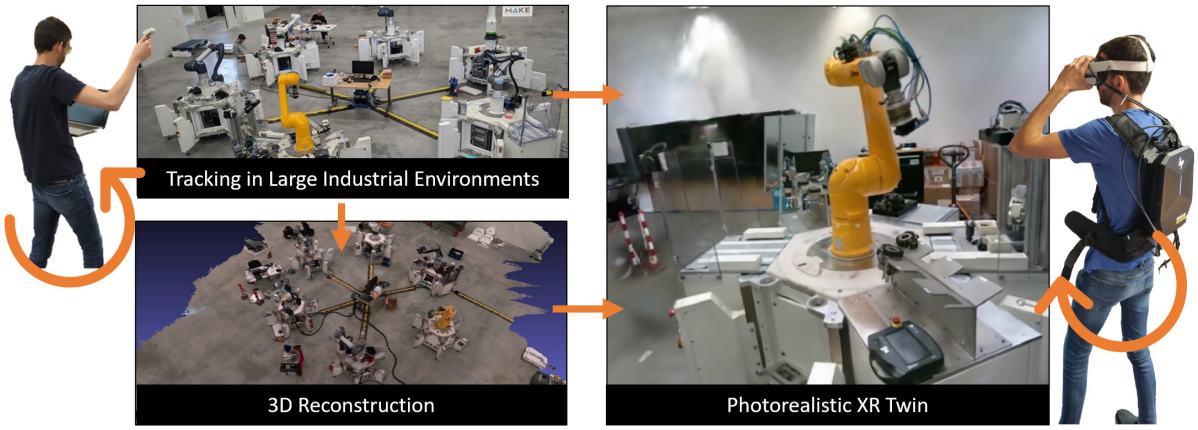

Figure 1: Example of how large area tracking is used to generate a photoeralistic XR Twin of an industrial environment.

Novelty of the submission

This presentation will introduce an innovative, state-of-the-art tracking technology that not only integrates seamlessly with existing off-the-shelf XR headsets but also enhances their performance in large-scale environments. Our solution addresses the critical challenge of drift in extensive spaces by employing a unique combination of SLAM-based tracking and physical ground truth landmarks. This approach ensures precise spatial alignment, allowing for the scaling of immersive virtual and physical performances to much larger areas than previously possible. By enabling synchronized, multi-participant experiences in both live cultural performances and industrial applications, this technology represents a significant advancement in large-area XR tracking. Furthermore, its flexibility for use in standalone headsets or remote-rendered environments makes it adaptable across a variety of sectors, from creative arts to manufacturing and construction.

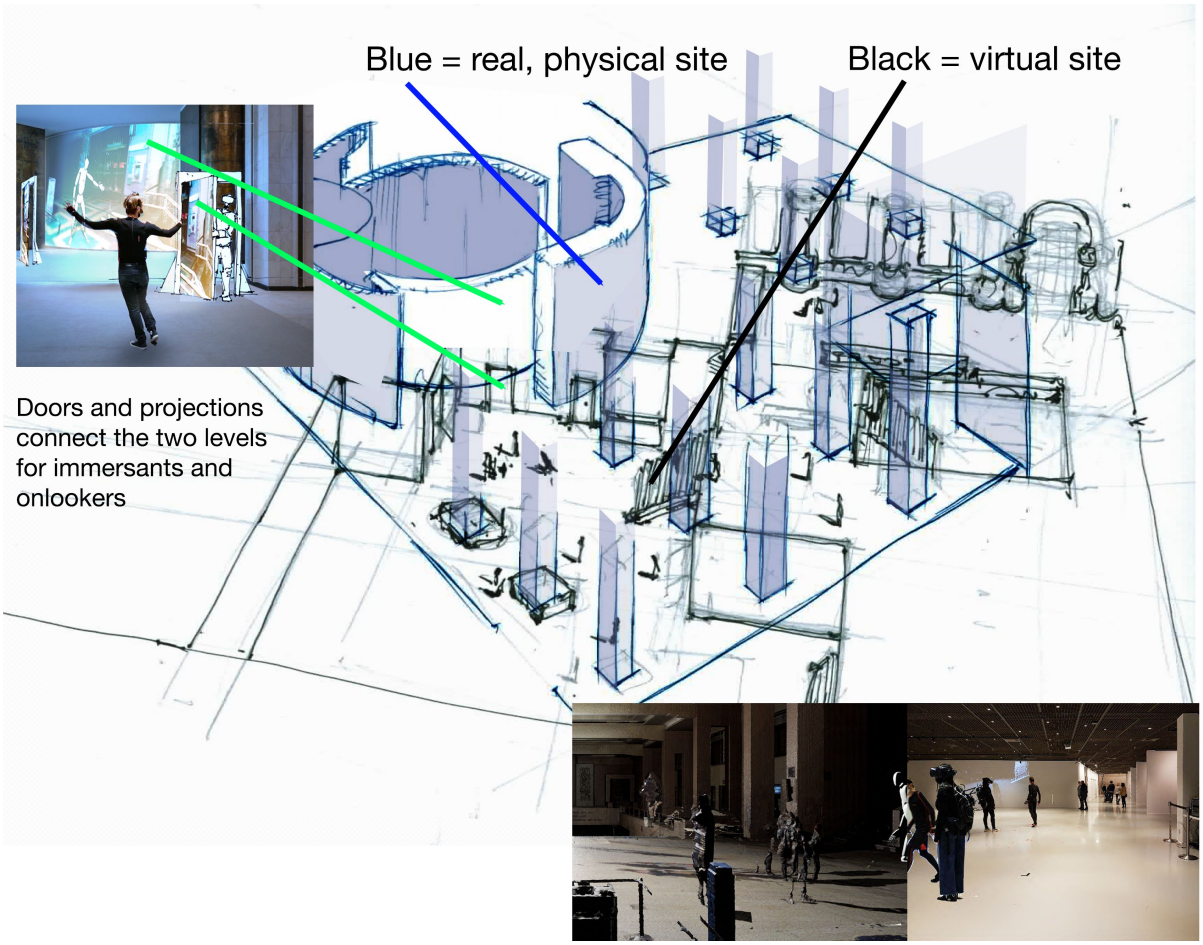

Figure 2: The CREW system allows for walking long distances for exploring equally large virtual spaces filled with stories e.g. a museum; the physical obstructions (walls, doors, desks,..) will be indicated in the virtual world.